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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/566,324

01/26/2006

Koichiro Minato

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12/17/2007

PATENTTM.US

P. O. BOX 82788

PORTLAND, OR 97282-0788

EXAMINER

THOMAS, ERIC W

ART UNIT

PAPER NUMBER

2831

MAIL DATE

DELIVERY MODE

12/17/2007

PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

## Office Action Summary

Application No.

10/566,324

Applicant(s)

MINATO ET AL.

Examiner

Eric Thomas

Art Unit

2831

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 01 October 2007.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1, 2 and 4 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1, 2 and 4 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 26 January 2006 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                       | 5) <input type="checkbox"/> Notice of Informal Patent Application                       |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

## INTRODUCTION

The examiner acknowledges, as recommended in the MPEP, the applicant's submission of the amendment dated 10/1/07. At this point, claim 1 has been amended, and claims 3 and 5 have been cancelled. Thus claims 1-2, 4 are pending in the instant application.

## DETAILED ACTION

### *Specification*

1. The listing of references in the specification is not a proper information disclosure statement. 37 CFR 1.98(b) requires a list of all patents, publications, or other information submitted for consideration by the Office, and MPEP § 609.04(a) states, "the list may not be incorporated into the specification but must be submitted in a separate paper." Therefore, unless the references have been cited by the examiner on form PTO-892, they have not been considered.

### *Claim Rejections - 35 USC § 103*

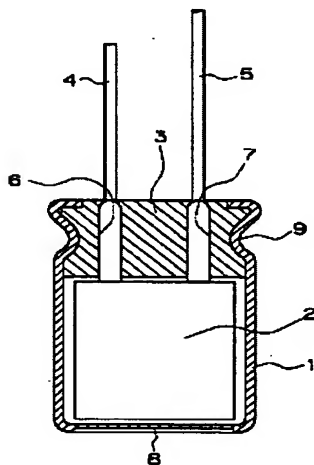
2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation

under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

4. Claims 1-2, and 4 are rejected under 35 U.S.C. 103(a) as being unpatentable over JP 2002-198270 ('270) in view of JP 01-135849 ('849).



'270 discloses an aluminum electrolytic capacitor (fig. 1) comprising a bottomed cylindrical metal case (1) for accommodating a capacitor element (2) having a driving electrolyte (see paragraphs 41-42) impregnated therein and an elastic sealing member sealing the open portion of the metal case (3).

'270 discloses the claimed invention except for the sealing member is made from a primary composition ethylene-propylene-diene three way copolymer rubber (EPDM) containing 30-70 wt% of ethylene and the glass transition temperature of the sealing member is in the range between -70 and -30 degrees C wherein the ethylene-propylene-diene three way copolymer (EPDM) is bridged with peroxide.

'849 teaches the use of an improved sealing material comprising a primary composition ethylene-propylene-diene three way copolymer rubber containing 30-70 wt% of ethylene (see page 2, col. 2, lines 4-20); wherein the sealing member has a glass transition temperature in the range between -70 and -30 degrees C (see page 2 col. 2 lines 4-5) wherein the ethylene-propylene-diene three way copolymer (EPDM) is bridged with peroxide.

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to use the sealing material of '849 in the capacitor of '270, since such a modification would seal the capacitor with a material having high compression and fatigue strength (see col. 2).

Regarding claim 2, '849 teaches that the diene in the EPDM comprises 1,4-hexadiene in the amount between 3-6 wt.% (0.5 – 10 wt%).

Regarding claim 4, '270 discloses the driving electrolyte comprises  $\gamma$  – butyrolactone and imidazolium salt (see paragraphs 41-42).

### ***Response to Arguments***

5. Applicant's arguments filed 10/1/07 have been fully considered but they are not persuasive.

Applicant's arguments:

A) JP 01-135849 does not show the glass transition temperature in the range between -70 to -30 degrees C.

B) The two documents relied on are not teaching the object of this invention that the capacitor should be kept sealed well at low temperatures. Even though these documents disclose a capacitor sealed with EPDM, one of ordinary skill in the art cannot combine the two document's inventions without the object to make a capacitor enduring at very low temperatures. Therefore, this invention is not obvious from the two documents.

-With respect to argument A, JP 01-135849 discloses on page 2 column 2, lines 4-5, the glass transition temperature is preferably -25 degrees C or lower. Even though the '849 patent is silent with respect to the glass transition temperature being in the range between -70 to -30 degree C, it is understood to be an inherent feature (if the claimed composition is physically the same, it must have the same properties).

**MPEP 2112.01 [R-3] I. PRODUCT AND APPARATUS CLAIMS — WHEN THE STRUCTURE RECITED IN THE REFERENCE IS SUBSTANTIALLY IDENTICAL TO THAT OF THE CLAIMS, CLAIMED PROPERTIES OR FUNCTIONS ARE PRESUMED TO BE INHERENT**

Where the claimed and prior art products are identical or substantially identical in structure or composition, or are produced by identical or substantially identical processes, a prima facie case of either anticipation or obviousness has been established. In re Best, 562 F.2d 1252, 1255, 195 USPQ 430, 433 (CCPA 1977). "When the PTO shows a sound basis for believing that the products of the applicant and the prior art are the same, the applicant has the burden of showing that they are not." In re Spada, 911 F.2d 705, 709, 15 USPQ2d 1655, 1658 (Fed. Cir. 1990). Therefore, the prima facie case can be rebutted by evidence showing that the prior art products do not necessarily possess the characteristics of the claimed product. In re Best, 562 F.2d at 1255, 195 USPQ at 433. See also Titanium Metals Corp. v. Banner, 778 F.2d 775, 227 USPQ 773 (Fed. Cir. 1985) (Claims were directed to a titanium alloy containing 0.2-0.4% Mo and 0.6-0.9% Ni having corrosion resistance. A Russian article disclosed a titanium alloy

containing 0.25% Mo and 0.75% Ni but was silent as to corrosion resistance. The Federal Circuit held that the claim was anticipated because the percentages of Mo and Ni were squarely within the claimed ranges. The court went on to say that it was immaterial what properties the alloys had or who discovered the properties because the composition is the same and thus must necessarily exhibit the properties.). See also *In re Ludtke*, 441 F.2d 660, 169 USPQ 563 (CCPA 1971) (Claim 1 was directed to a parachute canopy having concentric circumferential panels radially separated from each other by radially extending tie lines. The panels were separated "such that the critical velocity of each successively larger panel will be less than the critical velocity of the previous panel, whereby said parachute will sequentially open and thus gradually decelerate." The court found that the claim was anticipated by Menget. Menget taught a parachute having three circumferential panels separated by tie lines. The court upheld the rejection finding that applicant had failed to show that Menget did not possess the functional characteristics of the claims.); *Northam Warren Corp. v. D. F. Newfield Co.*, 7 F. Supp. 773, 22 USPQ 313 (E.D.N.Y. 1934) (A patent to a pencil for cleaning fingernails was held invalid because a pencil of the same structure for writing was found in the prior art.)

## **II. COMPOSITION CLAIMS — IF THE COMPOSITION IS PHYSICALLY THE SAME, IT MUST HAVE THE SAME PROPERTIES**

"Products of identical chemical composition can not have mutually exclusive properties." A chemical composition and its properties are inseparable. Therefore, if the prior art teaches the identical chemical structure, the properties applicant discloses and/or claims are necessarily present. *In re Spada*, 911 F.2d 705, 709, 15 USPQ2d 1655, 1658 (Fed. Cir. 1990) (Applicant argued that the claimed composition was a pressure sensitive adhesive containing a tacky polymer while the product of the reference was hard and abrasion resistant. "The Board correctly found that the virtual identity of monomers and procedures sufficed to support a prima facie case of unpatentability of Spada's polymer latexes for lack of novelty.").

## **III. PRODUCT CLAIMS – NONFUNCTIONAL PRINTED MATTER DOES NOT DISTINGUISH CLAIMED PRODUCT FROM OTHERWISE IDENTICAL PRIOR ART PRODUCT**

Where the only difference between a prior art product and a claimed product is printed matter that is not functionally related to the product, the content of the printed matter will not distinguish the claimed product from the prior art. *In re Ngai*, 367 F.3d 1336, 1339, 70 USPQ2d 1862, 1864 (Fed. Cir. 2004) (Claim at issue was a kit requiring instructions and a buffer agent. The Federal Circuit held that the claim was anticipated by a prior art reference that taught a kit that included instructions and a buffer agent, even though the content of the instructions differed.). See also *In re Gulack*, 703 F.2d 1381, 1385-86, 217 USPQ 401, 404 (Fed. Cir. 1983) ("Where the printed matter is not functionally related to the substrate, the printed matter will not distinguish the invention from the prior

art in terms of patentability .... [T]he critical question is whether there exists any new and unobvious functional relationship between the printed matter and the substrate.").

6. In response to applicant's argument B, the fact that applicant has recognized another advantage which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the differences would otherwise be obvious. See *Ex parte Obiaya*, 227 USPQ 58, 60 (Bd. Pat. App. & Inter. 1985).

**MPEP 2144 [R-5] RATIONALE MAY BE IN A REFERENCE, OR REASONED FROM COMMON KNOWLEDGE IN THE ART, SCIENTIFIC PRINCIPLES, ART RECOGNIZED EQUIVALENTS, OR LEGAL PRECEDENT**

The rationale to modify or combine the prior art does not have to be expressly stated in the prior art; the rationale may be expressly or impliedly contained in the prior art or it may be reasoned from knowledge generally available to one of ordinary skill in the art, established scientific principles, or legal precedent established by prior case law. In re Fine, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988); In re Jones, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). See also In re Kotzab, 217 F.3d 1365, 1370, 5 USPQ2d 1313, 1317 (Fed. Cir. 2000) (setting forth test for implicit teachings); In re Eli Lilly & Co., 902 F.2d 943, 14 USPQ2d 1741 (Fed. Cir. 1990) (discussion of reliance on legal precedent); In re Nilssen, 851 F.2d 1401, 1403, 7 USPQ2d 1500, 1502 (Fed. Cir. 1988) (references do not have to explicitly suggest combining teachings); *Ex parte Clapp*, 227 USPQ 972 (Bd. Pat. App. & Inter. 1985) (examiner must present convincing line of reasoning supporting rejection); and *Ex parte Levengood*, 28 USPQ2d 1300 (Bd. Pat. App. & Inter. 1993) (reliance on logic and sound scientific reasoning).

**THE EXPECTATION OF SOME ADVANTAGE IS THE STRONGEST RATIONALE FOR COMBINING REFERENCES**

The strongest rationale for combining references is a recognition, expressly or impliedly in the prior art or drawn from a convincing line of reasoning based on established scientific principles or legal precedent, that some advantage or expected beneficial result would have been produced by their combination. In re Sernaker, 702 F.2d 989, 994-95, 217 USPQ 1, 5-6 (Fed. Cir. 1983).

**LEGAL PRECEDENT CAN PROVIDE THE RATIONALE SUPPORTING OBVIOUSNESS ONLY IF THE FACTS IN THE CASE ARE SUFFICIENTLY SIMILAR TO THOSE IN THE APPLICATION**

The examiner must apply the law consistently to each application after considering all the relevant facts. If the facts in a prior legal decision are



sufficiently similar to those in an application under examination, the examiner may use the rationale used by the court. If the applicant has demonstrated the criticality of a specific limitation, it would not be appropriate to rely solely on case law as the rationale to support an obviousness rejection. "The value of the exceedingly large body of precedent wherein our predecessor courts and this court have applied the law of obviousness to particular facts, is that there has been built a wide spectrum of illustrations and accompanying reasoning, that have been melded into a fairly consistent application of law to a great variety of facts." *In re Eli Lilly & Co.*, 902 F.2d 943, 14 USPQ2d 1741 (Fed. Cir. 1990).

#### **RATIONALE DIFFERENT FROM APPLICANT'S IS PERMISSIBLE**

The reason or motivation to modify the reference may often suggest what the inventor has done, but for a different purpose or to solve a different problem. It is not necessary that the prior art suggest the combination to achieve the same advantage or result discovered by applicant. >See, e.g., *In re Kahn*, 441 F.3d 977, 987, 78 USPQ2d 1329, 1336 (Fed. Cir. 2006) (motivation question arises in the context of the general problem confronting the inventor rather than the specific problem solved by the invention); *Cross Med. Prods., Inc. v. Medtronic Sofamor Danek, Inc.*, 424 F.3d 1293, 1323, 76 USPQ2d 1662, 1685 (Fed. Cir. 2005) ("One of ordinary skill in the art need not see the identical problem addressed in a prior art reference to be motivated to apply its teachings."); < *In re Linter*, 458 F.2d 1013, 173 USPQ 560 (CCPA 1972) (discussed below); *In re Dillon*, 919 F.2d 688, 16 USPQ2d 1897 (Fed. Cir. 1990), cert. denied, 500 U.S. 904 (1991) (discussed below). Although *Ex parte Levengood*, 28 USPQ2d 1300, 1302 (Bd. Pat. App. & Inter. 1993) states that obviousness cannot be established by combining references "without also providing evidence of the motivating force which would impel one skilled in the art to do what the patent applicant has done" (emphasis added), reading the quotation in context it is clear that while there must be motivation to make the claimed invention, there is no requirement that the prior art provide the same reason as the applicant to make the claimed invention. In *In re Linter* the claimed invention was a laundry composition consisting essentially of a dispersant, cationic fabric softener, sugar, sequestering phosphate, and brightener in specified proportions. The claims were rejected over the combination of a primary reference which taught all the claim limitations except for the presence of sugar, and secondary references which taught the addition of sugar as a filler or weighting agent in compositions containing cationic fabric softeners. Appellant argued that in the claimed invention, the sugar is responsible for the compatibility of the cationic softener with the other detergent components. The court sustained the rejection, stating "The fact that appellant uses sugar for a different purpose does not alter the conclusion that its use in a prior art composition would be [sic, would have been] *prima facie* obvious from the purpose disclosed in the references." 173 USPQ at 562. In *In re Dillon*, applicant claimed a composition comprising a hydrocarbon fuel and a sufficient amount of a tetra-orthoester of a specified formula to reduce

the particulate emissions from the combustion of the fuel. The claims were rejected as obvious over a reference which taught hydrocarbon fuel compositions containing tri-orthoesters for dewatering fuels, in combination with a reference teaching the equivalence of tri-orthoesters and tetra-orthoesters as water scavengers in hydraulic (nonhydrocarbon) fluids. The Board affirmed the rejection finding "there was a reasonable expectation' that the tri- and tetra-orthoester fuel compositions would have similar properties based on close structural and chemical similarity' between the tri- and tetra-orthoesters and the fact that both the prior art and Dillon use these compounds as fuel additives'." 919 F.2d at 692, 16 USPQ2d at 1900. The court held "it is not necessary in order to establish a prima facie case of obviousness . . . that there be a suggestion or expectation from the prior art that the claimed [invention] will have the same or a similar utility as one newly discovered by applicant," and concluded that here a prima facie case was established because "[t]he art provided the motivation to make the claimed compositions in the expectation that they would have similar properties." 919 F.2d at 693, 16 USPQ2d at 1901 (emphasis in original).

**Conclusion**

7. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Eric Thomas whose telephone number is 571-272-1985. The examiner can normally be reached on Monday - Friday 5:30 AM - 2:00 PM.


Application/Control Number:  
10/566,324  
Art Unit: 2831

Page 10

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Diego Gutierrez can be reached on 571-272-2245. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

ewt



12-5-07

Eric Thomas  
Primary Examiner—2831

PTO 08-0155

CC=JP DATE=19890529 KIND=A  
PN=01135849

VULCANIZABLE RUBBER COMPOSITION  
[Karyu Kanona Gomu Soseibutsu]

Obrecht Werner, et al.

UNITED STATES PATENT AND TRADEMARK OFFICE  
Washington, D.C. October 2007

Translated by: FLS, Inc.

PUBLICATION COUNTRY	(19):	JP
DOCUMENT NUMBER	(11):	01135849
DOCUMENT KIND	(12):	A
	(13):	PUBLISHED UNEXAMINED APPLICATION (Kokai)
PUBLICATION DATE	(43):	19890529
PUBLICATION DATE	(45):	
APPLICATION NUMBER	(21):	63260695
APPLICATION DATE	(22):	19881018
INTERNATIONAL CLASSIFICATION	(51):	C08L 21/00, C08K 3/22
INVENTORS	(72):	WERNER, OBRECHT; ZSOLT, SZENTIVANYI
APPLICANT	(71):	BAYER AKTIENGESELLSCHAFT
TITLE	(54):	VULCANIZABLE RUBBER COMPOSITION
FOREIGN TITLE	[54A]:	Karyu Kanona Gomu Soseibutsu

## 1. Title

Vulcanizable Rubber Composition

## 2. Claims

1. A method for producing vulcanizable rubber compositions by mixing rubber and additives, said method comprising adding, in addition to sulfur and/or a sulfur donor, a peroxide of a minimum of one kind of metal selected from Groups Ia, Ib, IIa, and IIb of the periodic table of the elements in a quantity of from 0.1 to 20 % by weight, based on the rubber.

2. Rubber compositions that are obtained by the method described in Claim 1.

3. Use of the rubber compositions described in Claim 2 in the manufacture of vulcanized rubber products.

## 3. Detailed Description of the Invention

The present invention pertains to a method for producing vulcanizable compositions having rubber as the base material with the use of certain kinds of peroxides, and it also pertains to products obtained by this method and also to their use in the manufacture of vulcanized rubber products.

Vulcanization accelerators are well known as substances that shorten the vulcanization time or that make it possible to carry out ~~vulcanization at lower temperatures~~ (Ullmanns Encyklopädie der

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\* Number in the margin indicates pagination in the foreign text.

technischen Chemie, third edition, Urban and Schwarzenberg, Munich-Berlin, 1957; See p. 383 and those that follow.) For the purpose of maximizing the effects of vulcanization accelerators, organic or preferably inorganic activators are added. The most important inorganic activators are metal oxides, especially zinc oxide. Magnesium oxide and calcium hydroxide may be used in some cases.

Surprisingly, it was discovered here that, if certain kinds of peroxides are added to rubber compounds while the use of the aforesaid activators is optionally eliminated entirely or partially, the products obtained after the vulcanization effected by sulfur and/or a sulfur donor ~~have improved compression-set values, higher sealing resistance, and lower heat generation~~ (better fatigue strength) in a flexometer.

The use of zinc peroxide as the activator of the sulfur used as a vulcanizing agent is disclosed in UP-PS 3 403 136, but, in this /390 specification, the use of the sulfur/peroxide system is recommended only for rubber containing from 1 to 40 % carboxyl groups. Accordingly, this system is not expected to provide any advantage in rubber that does not contain carboxyl groups.

The present invention pertains to a method for producing vulcanizable rubber compositions by mixing rubber and additives, said method comprising adding, in addition to sulfur and/or a sulfur donor, a peroxide of a minimum of one kind of metal selected from Groups Ia, Ib, IIa, and IIb of the periodic table of the elements in a quantity

of from 0.1 to 20 % by weight, preferably from 1 to 5 % by weight, based on the rubber.

The present invention further pertains to products that are manufactured by this method and also to their use in the manufacture of vulcanized rubber products.

Rubbers that are preferably used in the method described in the present invention include natural rubber, polychloroprene, ethylene/propylene-base polymers (EPDM) having double bonds, butyl rubber, polybutadiene, styrene/butadiene copolymers, acrylonitrile/butadiene copolymers, and partially hydrogenated products thereof, which are especially desirable.

~~These rubbers preferably have a glass transition temperature of 0°C or below, better yet, 25°C or below.~~

The term "EPDM" used herein means ethylene/propylene/diene terpolymers. EPDM includes rubbers whose weight ratio of ethylene groups to propylene groups is in the range of from 40:60 to 65:35, and they can contain from 1 to 20 C=C double bonds per 1000 carbon atoms. The following are examples of suitable diene monomers in the EPDM: conjugated dienes, such as isoprene and 1,3-butadiene; nonconjugated dienes having from 5 to 25 carbon atoms, such as 1,4-pentadiene, 1,4-hexadiene, 1,5-hexadiene, 2,5-dimethyl-1,5-hexadiene, and 1,4-octadiene; cyclic dienes, such as cyclopentadiene, cyclohexadiene, cyclooctadiene, and dicyclopentadiene; alkylidene norbornenes and alkenyl norbornenes, such as 5-ethylidene-2-norbornene, 5-butyldiene-



2-norbornene, 2-methallyl-5-norbornene, 2-isopropenyl-5-norbornene; and tricyclodienes.

Among these, 1,5-hexadiene, which is a nonconjugated diene, ethylidene norbornene, and dicyclopentadiene are preferable. The diene content in the EPDM is preferably from 0.5 to 10 % by weight, based on the EPDM.

EPDM rubbers of this type are disclosed in, for example, DE-OS 2 808 709.

The term "butyl rubber" used in the present invention encompasses isobutene copolymers that are comprised of from 95 to 99.5 % by weight, preferably from 97.5 to 99.5 % by weight, of isobutene and from 0.5 to 5 % by weight, preferably from 0.5 to 2.5 % by weight, of copolymerizable diene--for example, butadiene, dimethyl butadiene, 1,3-pentadiene, or isoprene, which is especially desirable. On an industrial scale, butyl rubber is nearly exclusively manufactured in the form of isobutene/isoprene copolymer form by cationic solution polymerization at low temperature (see, for example, Kirk-Othmer, Encyclopedia of Chemical Technology, 2nd ed., Vol. 7, p. 688, Interscience Publ., New York-London-Sydney, 1965, and Winnacker-Küchler, Chemische Technologie, 4th ed., Vol. 6, pp. 550-555, Carl Hanser Verlag, Munich-Vienna, 1962.)

For the method described in the present invention, "partially" hydrogenated nitrile rubber is especially preferable. The term "partially hydrogenated" used in the present specification means that

from 90 to 98.5 %, preferably from 95 to 98 %, of C=C double bonds (that is, units that are usually derived from butadiene) that can be hydrogenated are hydrogenated. The degree of hydrogenation can be determined by IR [infrared] spectroscopy.

The hydrogenation of nitrile rubber has already been disclosed in, /391 for example, US-PS 3 700 637, DE-OS 25 39 132, 30 46 008, 30 46 251, 32 27 605, and 33 29 974, EP-A 111 412, and FR-PS 2 540 503. The main characteristic of hydrogenated nitrile is its relatively high oxidation resistance.

Rubbers that are suitable for use in the method described in the present invention usually have a Mooney viscosity (DIN 53 523, ML 1+4) of from 10 to 150 MU, preferably from 25 to 80 MU. They essentially contain no carboxyl groups. That is to say, they only contain 0.8 % by weight or less, preferably 0.5 % by weight or less, better yet, 0.3 % by weight or less, carboxyl groups, based on the quantity of the rubber.

Peroxides that are preferably used in the method of the present invention are sodium peroxide, barium peroxide, and zinc peroxide, which is the most desirable.

Vulcanization aids and, if necessary, fillers (for example, carbon black), plasticizers, anti-aging agents, and/or process aids are added to the rubber in ordinary quantities prior to the vulcanization.

The vulcanization with the use of sulfur or a sulfur donor can be implemented by ordinary methods. The quantity of sulfur used as the vulcanizing agent is usually from 0.2 to 0.3 % (in terms of the quantity of the released sulfur in the case of using a sulfur donor) by weight based on the quantity of the rubber.

The vulcanizing agent here preferably does not contain any compounds that can act as a vulcanizing agent only in the presence of an oxidant, examples of such compounds being 1,3,5-trinitrobenzene, m-dinitrobenzene, quinones, halogen derivatives thereof, quinone mono- and di-imines, and p-quinone mono- and di-oximes.

The vulcanized rubber products obtained according to the method described in the present invention are excellent materials for power transmission belts and synchronous belts, such as V-belts, poly-V-belts, and timing belts. In this application, the high restoring power of the rubber products is highly useful. These products also have excellent properties as various types of sealing materials.

In the following working examples, the term "parts" indicates parts by weight, and percentage is percent by weight.

## Working Examples

### Working Example 1

	[parts]
HNBR <sup>1)</sup>	100
Plasticizer (aromatic polyether)	5
Carbon black N 774	65
Stearic acid	1
Octylated diphenylamine	1.5
Zinc salt of mercaptobenzimidazole	2
Ether thioether (plasticizer)	5
	<u>179.5</u>

- 1) A hydrogenated acrylonitrile/butadiene copolymer having an acrylonitrile content of 34 %, a hydrogenation degree of 96 %, based on C=C double bonds, and a Mooney viscosity (ML 1+4) of 70 ME.

The aforesaid ingredients were mixed with a kneader (Batch 1).

	A	B
Batch 1	179.5	179.5
Sulfur	0.2	0.2
Zinc oxide	5	--
Zinc peroxide	--	5
TMTD <sup>2)</sup>	1.4	1.4
TETD <sup>3)</sup> (75 % by weight in EVA)	2.25	2.25
Dithiodicaproloactam (80 % in EVA)	2.2	2.2
Mooney viscosity (ML 1+4)	150 ME	100 ME

- 2) Tetramethyl thiuram disulfide.

- 3) Tetraethyl thiuram disulfide.

The vulcanization was conducted at 170 °C for 15 minutes. The compression set at 100 °C after 70 hours was found to be 74 % (A) and 59 % (B).

	C	D	E	F
	(a)			
(b) バッチ 1	179.5	179.5	179.5	179.5
(c) 硫黄	0.5	0.5	0.5	0.5
(d) 酸化亜鉛	5	1.5	0.5	-
(e) 過酸化亜鉛	-	3.5	4.5	5
TMTD "	2	2	2	2
CBS "	0.5	0.5	0.5	0.5
(f) ムーニー粘性	113	108	108	105
(ML 1+4)				
(ME)				

Key: a) parts; b) batch 1; c) sulfur; d) zinc oxide; e) zinc peroxide; f) Mooney viscosity.

#### 4) Benzothiazolyl-2-cyclohexyl sulfenamide.

The above mixtures were vulcanized at 170 °C for 15 minutes and then tempered at 150 °C for 7 hours. The obtained products had the following properties.

	C	D	E	F
(a) 圧縮率 (%)				
(b) 100° 70 時間後	52	32	31	32
(c) 125° 70 時間後	78	57	50	50
(d) 応力緩和 (%)				
(DIN 53 537/125°)				
(e) 24 時間後	35	24	23	25
(f) 72 時間後	49	40	37	40
(g) 168 時間後	62	51	48	52

Key: a) compression set; b) after 70 hours at 100 °C; c) after 70 hours at 125 °C; d) stress relaxation; e) 24 hours later; f) 72 hours later; 168 hours later.

### Working Example 3

	G	H	I	K
	[部] (a)			
H N B R	90	90	100	100
(b) ポリシクロオクタジエン <sup>*)</sup>	10	10	-	-
(c) カーボンブラック				
ク N 550	45	45	45	45
(d) 硫黄	0.5	0.5	0.5	0.5
(e) 酸化亜鉛	5	-	5	-
(f) 過酸化亜鉛	-	5	-	5
(g) ステアリン酸	1	1	1	1
(h) スチレン化ジフェニルアミン	1.5	1.5	1.5	1.5
(i) メルカプトベンズイミダゾール				
ルの亜鉛塩	2	2	2	2
(j) エーテルチオエーテル				
エーテル	5	5	5	5
T M T D <sup>*)</sup>	2	2	2	2
C B S <sup>*)</sup>	0.5	0.5	0.5	0.5
(k) ムーニー粘性 (ML 1+4)	87	82	94	91
(ME)				

Key: a) parts; b) polycyclooctadiene; c) carbon black; d) sulfur; e) zinc oxide; f) zinc peroxide; g) stearic acid; h) styrenated diphenylamine; i) zinc salt of mercaptobenzimidazole; j) ether thioether; k) Mooney viscosity.

5) Trans content: 80 %, the viscosity of its 0.1 % toluene solution (0.4 mm capillary tube/25 °C): 120 mL/g.

The vulcanization was conducted at 170 °C for 15 minutes.

	G	H	I	K
(a) 圧縮率 (%)				
(b) 25°C 70 時間後	18	13	13	10
(c) 100°C 70 時間後	68	51	67	53
(d) フレクソメーター試験 <sup>*)</sup> , 100°C				
Δ T (°C)		34	37	30
(e) 流動 (%)		1.3	2.1	1.7
(f) 永久変形 (%)		3.9	9.0	3.5

Key: a) compression set; b) after 70 hours at 25 °C; c) after 70 hours at 100 °C; d) flexometer test; e) fluidity; f) permanent set.

6) In a flexometer in accordance with DIN 53 533. Vehicle tension: 1 MPa; stroke: 4.45 mm; frequency: 30 Hz; and test time: 25 minutes.

Working Example 4 (Mixtures for tire tread surface)

	L	M	N	O
	(a)			
SBR 1"	-	-	103	103
SBR 2"	100	100	-	-
BR "	-	-	25	25
(b) カーボンブラック				
ク N 339	70	70	70	70
(c) 鉱油	40	40	2.5	2.5
(d) 硫黄	1.8	1.8	1.8	1.8
(e) ステアリン酸	1	1	1	1
(f) N-イソプロピル-N-フェニル-p-フェニレンジアミン				
ル-N-フェニル				
ル-p-フェニル				
レンジアミン	1.5	1.5	1.5	1.5
(g) 酸化亜鉛	5	-	5	-
(h) 過酸化亜鉛	-	5	-	5
CBS "	1.5	1.5	1.5	1.5
TMTM "	-	-	0.2	0.2

/393

Key: a) parts; b) carbon black; c) mineral oil; d) sulfur; e) stearic acid; f) N-isopropyl-N-phenyl-p-phenylene diamine; g) zinc oxide; h) zinc peroxide.

7) A styrene/butadiene copolymer containing 23.5 % styrene. Mixed with 27.5 % of oil. Mooney viscosity (ME 1+4): 49 ME.

8) The same as 7, except that no oil was mixed. 50 ME.

9) Polybutadiene (cis content: 95 %), Mooney viscosity (ME 1+4): 47 ME.

10) Tetramethylene thiuram monosulfide.

The vulcanization was conducted at 170 °C for 15 minutes (standard ring I). The following results were obtained.

	L	M	N	O
(a) 圧縮率 [%]				
(b) 25°C 70 時間後	12.9	8.8	9.9	9.3
(c) フレクソメーター				
試験条件: 80°C				
ΔT [°C]	51	35.4	28.3	26.2
(d) 流動 [%]	13.5	10.2	3.4	3.0
(e) 永久変形 [%]	19.8	15.6	5.5	5.5

Key: a) compression set; b) after 70 hours at 25 °C; c) flexometer test; d) fluidity; e) permanent set.

### Working Example 5

	(a) P (比較例)	Q	R
NBR 111	100	100	100
(b) 芳香族ポリ エーテル	5	5	5
(c) 硫黄	0.3	0.3	0.3
(d) 酸化亜鉛	4	-	0.5
(e) 過酸化亜鉛	-	5.2	4.5
(f) カーボン ブラック	55	55	55
(g) ステアリン酸	0.7	0.7	0.7
(h) エーテルチオ エーテル	8	8	8
(i) 4- または 5-メ チルメルカプ トベンズイミ ダゾールの 亜鉛塩	2.5	2.5	2.5
(j) スチレン化ジフ ェニルアミン	1	1	1
(k) ポリ-2,2,4-ト リメチル-1, 2-ジヒドロ キノリン	1	1	1
TM TD <sup>11</sup>	1.5	1.5	1.5
TE TD <sup>11</sup>	1.5	1.5	1.5
(l) ジベンゾチアゾ リルジスル フィド	2	2	2
(m) N-シクロヘキ シルチオアフラ リミド	0.2	0.2	0.2
(n) ムーニー粘性	63	60	60
(ML 1+4)			
(MEI)			

Key: a) comparative example; b) aromatic polyether; c) sulfur; d) zinc oxide; e) zinc peroxide; f) carbon black; g) stearic acid; h) ether thioether; i) zinc salt of 4- or 5-methyl mercaptobenzimidazole; j)



styrenated diphenylamine; k) poly-2,2,4-trimethyl-1,2-dihydroquinone; l) dibenzothiazolyl disulfide; m) N-cyclohexyl thiophthalimide; n) Mooney viscosity.

11) An acrylonitrile/butadiene copolymer having an acrylonitrile content of 28 % and a Mooney plasticity [sic] (ML 1+4) of 45 ME.

These mixtures were vulcanized at 170 °C for 15 minutes and tempered at 150 °C for 2 hours. The properties shown below were obtained.

/394

	P	Q	R
(a) 圧縮率 (%)			
(b) 100℃ 168 時間後	36.4	35.0	33.8
(c) フレクソメーター			
試験条件, 100℃			
Δ T (℃)		43.1	42.3
(d) 流動 (%)		0.5	0.25
(e) 永久変形 (%)		2.8	2.8

Key: a) compression set; b) after 168 hours at 100 °C ; d) flexometer test; e) fluidity; f) permanent set.

12) In a flexometer in accordance with DIN 53 533. Vehicle tension: 1 MPa; stroke: 5.71 mm; frequency: 30 Hz; and test time: 25 minutes.

The main features and mode of the present invention are as follows.

1. A method for producing vulcanizable rubber compositions by mixing rubber and additives, said method comprising adding, in addition to sulfur and/or a sulfur donor, a peroxide of a minimum of one kind of metal selected from Groups Ia, Ib, IIa, and IIb of the

periodic table of the elements in a quantity of from 0.1 to 20 % by weight, based on the rubber.

2. The method described in Item 1, wherein from 1 to 5 % by weight of a peroxide is added.

3. The method described in Items 1 or 2, wherein the peroxide is zinc peroxide.

4. Rubber compositions that are obtained by the method described in the aforesaid Items 1 through 3.

5. Use of the rubber compositions described in the aforesaid Item 4 in the manufacture of vulcanized rubber products.